

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

# PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:  
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Date of mailing  
(day/month/year) **29 AUG 2005**

Applicant's or agent's file reference

620002-2930

**FOR FURTHER ACTION**

See paragraph 2 below

International application No.

PCT/US05/05088

International filing date (day/month/year)

16 February 2005 (16.02.2005)

Priority date (day/month/year)

19 February 2004 (19.02.2004)

International Patent Classification (IPC) or both national classification and IPC

IPC(7): H01M 8/10 and US Cl.: 429/30-34, 46; 427/115

Applicant

GEORGIA TECH RESEARCH CORP.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

## 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US

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**Box No. I Basis of this opinion**

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.  
☐ This opinion has been established on the basis of a translation from the original language into the following language \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material  
☐ a sequence listing  
☐ table(s) related to the sequence listing
  - b. format of material  
☐ in written format  
☐ in computer readable form
  - c. time of filing/furnishing  
☐ contained in international application as filed.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

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**Box No. II Priority**

1. ☐ The following document has not yet been furnished:

☐ copy of the earlier application whose priority has been claimed (Rules 43*bis*.1 and 66.7(a)).

☐ translation of the earlier application whose priority has been claimed (Rules 43*bis*.1 and 66.7(b)).

Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☒ This opinion has been established as if no priority has been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

The priority claim is considered invalid because none of the claims are supported by the priority application.

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**Box No. IV Lack of unity of invention**

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has:
- ☒ paid additional fees
- ☐ paid additional fees under protest
- ☐ not paid additional fees
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with
- ☒ not complied with for the following reasons:
- See the lack of unity section of the International Search Report(Form PCT/ISA/210)

4. Consequently, this opinion has been established in respect of the following parts of the international application:
- ☒ all parts.
- ☐ the parts relating to claims Nos. \_\_\_\_\_

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**Box No. V Reasoned statement under Rule 43 bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims <u>7, 9, 16, 17 and 20-30</u>	YES
	Claims <u>1-6, 8, 10-15 and 18-19</u>	NO
Inventive step (IS)	Claims <u>9, 16, 17 and 20-30</u>	YES
	Claims <u>1-8, 10-15 and 18-19</u>	NO
Industrial applicability (IA)	Claims <u>1-30</u>	YES
	Claims <u>NONE</u>	NO

2. Citations and explanations:

Please See Continuation Sheet

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**Box No. VII Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

The description is objected to as containing the following defect(s) under PCT Rule 66.2(a)(iii) in the form or contents thereof: on page 9, at line 33, the substrate "12" should be substrate "22" as the paragraph therein appears to relate to the substrate 22.

The drawings are objected to under PCT Rule 66.2(a)(iii) as containing the following defect(s) in the form or content thereof: reference character "14" in Fig. 2 should be "14a".

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**Box No. VIII Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the questions whether the claims are fully supported by the description, are made:

Claims 1-8, 10, 11-14, 18-20, 22-27 and 30 are objected to as lacking clarity under PCT Rule 66.2(a)(v) because of the claims not fully supported by the description. The description does not disclose the claimed invention in a manner sufficiently clear and complete for the claimed invention to be carried out by a person skilled in the art because: These claims define fuel cells and methods of making which are void of the requisite electrodes and catalyst materials for each electrode to effectively function as a fuel cell. Note that the claims not included in this objection define fuel cells having opposing electrode catalytic regions and thus effectively operate as a fuel cell. In comparison, claim 1 defines a fuel cell having a membrane. The scope of the invention defined therein extends beyond any known functional fuel cell since it does not include the electrode/catalyst materials to render the claimed invention an operational fuel cell. Furthermore with respect to claims 13 and 14, the disclosure fails to support a catalyst arrangement on the substrate surface in the anode channels and not the membrane surface. This arrangement is not clearly described with respect to how the anode catalyst which is not in surface contact with the proton exchange membrane is configured to provide electrochemical activity.

Claims 1-30 are objected to as lacking clarity under PCT Rule 66.2(a)(v) because of the claimed materials not fully supported by the description. The description does not disclose the claimed invention in a manner sufficiently clear and complete for the claimed invention to be carried out by a person skilled in the art because: The description does not support the membrane being an organic material or combination of organic and inorganic materials. A review of the disclosure only provides reasonable enablement for inorganic membrane materials.

Claims 1-30 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claims indefinite for the following reason(s): the exact scope of materials readily appreciated by the instant application as materials constituting the claimed membrane is not clearly defined. Even the genus of inorganic materials listed in some of the claims is unclear as to what metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides and combinations of all of the materials were appreciated by the instant application at the time the invention was made

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**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.

**V. 2. Citations and Explanations:**

Claims 1-6, 8, 10-15 and 18-19 lack novelty under PCT Article 33(2) as being anticipated by U.S. Patent Application Publication No. 2002/0020053 (Fonash).

Fonash discloses a fuel cell comprising a SiO<sub>2</sub> membrane (paragraph [0150] and table 9) wherein the thickness is 3900 Angstroms (or 0.390 nanometers). The material of the membrane is the same material, SiO<sub>2</sub> as discussed and claimed in the instant application and within the same thickness range of the instant application and is expected to exhibit the same area resistivity (as applied to claims 1-6 and 10).

The catalyst material includes platinum (paragraph [0150] as applied to claim 8).

The fuel cell includes a silicon substrate having anode current collectors, a silicon dioxide membrane at a thickness of 0.39 microns, hollow anode channels defined by the silicon substrate and membrane wherein the anode collectors are disposed, a cathode current collector on the opposite side of the membrane, wherein there is an electrically conductive path between the catalyst layer and the anode collector (Fig. 9 as applied to claim 11). The material of the membrane is the same material, SiO<sub>2</sub> as discussed and claimed in the instant application and within the same thickness range of the instant application and is expected to exhibit the same area resistivity (as applied to claim 11). The fuel cell arrangement in Fig. 9 further shows the same catalyst arrangement in the Silicon substrate (Fig. 9 as applied to claims 12-14). Note the arrangement of claims 13 and 14 not being readily shown in the figures and not clearly understood since the catalyst layer being applied to the substrate portion of the channels would not be in contact with the electrolyte of the membrane electrode assembly (MEA). The fuel cell arrangement in Fig. 9 further shows the same catalyst arrangement for the cathode in relation to the membrane (Fig. 9 as applied to claim 15).

The catalyst material includes platinum (paragraph [0150] as applied to claim 18).

The material of the membrane is the same material, SiO<sub>2</sub> as discussed and claimed in the instant application and within the same thickness range of the instant application and is expected to exhibit the same area resistivity (as applied to claims 19).

Claim 7 lacks an inventive step under PCT Article 33(3) as being obvious over Fonash in view of either U.S. Patent Application No. 2004/0197629 (Arishima) or U.S. Patent No. 6,524,750 (Mansuetto).

The concept of doping silicon dioxide with various additives such as boron, phosphorous, arsenic, etc., is a well-established concept for the purpose of improving the ionic mobility across the SiO<sub>2</sub> film (see paragraph [0039] of Arishima or col. 1, ll. 10-26 of Mansuetto). Note the application of Arishima is valid since the priority claim is held to be invalid for failing to fully support the claimed invention and more particularly of the doped silicon dioxide of claim 7.

Claims 9, 16, 17 and 20-30 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

- a. Providing a polymer layer on the second side of the membrane (claims 9 and 16-17). The bilayer arrangement of the membrane and polymer layer provides a combination which gives rise to an electrolyte having superior ionic conductivity, fuel crossover resistance and mechanical strength over either layer individually.
- b. The method of claims 20-30 including the process steps of disposing a sacrificial polymer layer, removing portions of the material and after additional process steps defined in the claim, removing the sacrificial material portions to form the hollow channels. The process of Fonash does not appear to be similar to this process.

Claims 1-30 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.



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**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.

With respect to the priority claim, the U.S. Provisional Application 60/545,772 filed 19 February 2004, does not provide clear and convincing support for the claimed invention and is noticeably void of the specific limitations defined in the claims of this PCT application. Therefore the claim to priority has not been granted and the filing date of this PCT application is 16 February 2005.